Laboratory for Computational Cultural Dynamics

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University of Maryland

www.cs.umd.edu/projects/lccd

A partnership with sociologists, anthropologists, political scientists, policy experts, linguists, and health care professionals.

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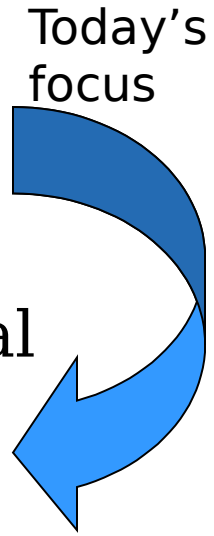
Motivation



- Overall goal is to develop the computational infrastructure needed to help others
  - » War/Counter-Terrorism: how can we get different tribes/groups in a region to do what we'd like them to do?
  - » Global Health: how do social/cultural behaviors contribute to the spread of infectious diseases?
  - » Post-Conflict Reconstruction: how can we set up an infrastructure in a country that has gone through a period of internal (or oth

All of these factors affect us.

LCCD Work with AFOSR

- Basic theoretical foundation to build applications that reason about different cultures (to some extent).
- Software platform based on the above theory for application development.
- Instantiate the above theory and system with a cultural context for the Pakistan/Afghanistan borderlands.
- Also studying terror groups in Peru.

- Cultural Advisory Board
  - » Deputy Minister of the Interior of Afghanistan (till July 05) who negotiated the release of UN hostages in Afghanistan in 2004.
  - » Former State Dept. offical stationed in Pakistan
  - » A well known author about Pak/Afghan tribes
  - » Former Peruvian General who arrested many of the *Shining Path* and *Tupac Amaro* terrorist leaders.

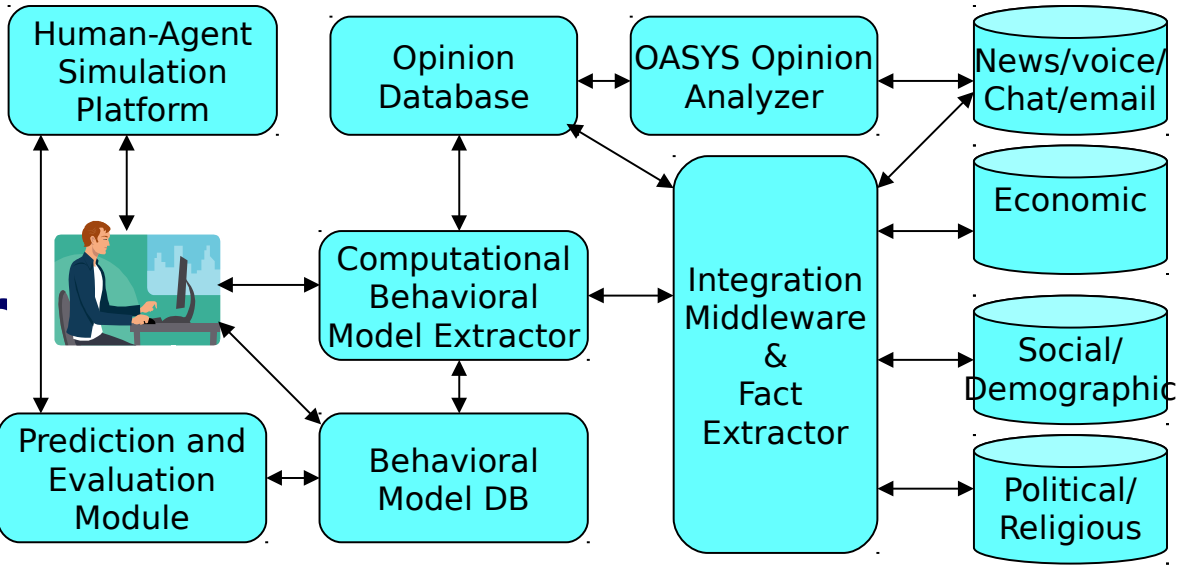
TURKMENISTAN
UZBEKISTAN
TAJIKISTAN
CHINA
IRAN
PAKISTAN
INDIA
Dushanbe
Kulyab
Taxkorgan
Khorog
Feyzābād
Lasht
Eshkāshem
BADAKHSHAN
Kurgan-Tyube
Nizhniy Pyandzh
Termez
Keleft
Jeyretān
Mazār-e Sharif
Kholm
Sheberghān
JOWZJAN
BALKH
KONDOZ
Konduz
Tāloqān
TAKHAR
Samangān
SAMANGAN
Baghlān
Pol-e Khomri
BAGHLAN
Sar-e Pol
SAR-E POL
Meymaneh
FARYAB
Chitrāl
KONAR
Mahmūd-e Rāqi
LAGHMAN
Asadābād
Cease-Fire Line
Kushka
BADGHIS
Towraghondi
Tayyebāt
Qal'eh-ye Now
Herāt
HERAT
Chaghcharān
GHOWR
BAMIAN
Bāmīān
Chārīkār
PARWAN
Mehtarlām
Kowt-e Ashrow
Kabul
KABUL
Jalālābād
NANGARHAR
Khyber Pass
Landi Kotal
Peshāwar
Islāmābād
Pārachinār
Baraki
LOWGAR
Gardeyz
PAKTIA
Khowst
Ghazni
GHAZNI
ORUZGAN
Shindand
Tarin Kowt
Zareh Sharan
PAKTIKA
FARAH
Farāh
Dolārām
Qalāt
ZABOL
Lashkar Gāh
HELMAND
Qandahār
KANDAHĀR
Zaranj
NIMRUZ
Zābol
Zhob
Chaman
Quetta
Zāhedān
Nok Kundi
Dālbandin
Afghanistan
International boundary
Province boundary
National capital
Province capital
Railroad
Road
0 100 200 Kilometers
0 100 200 Miles
Lambert Conformal Conic Projection, SP 12N/38N

What is the Context in which Terror Breeds?

Cultural contextual information is stored in a wide variety of existing data sources

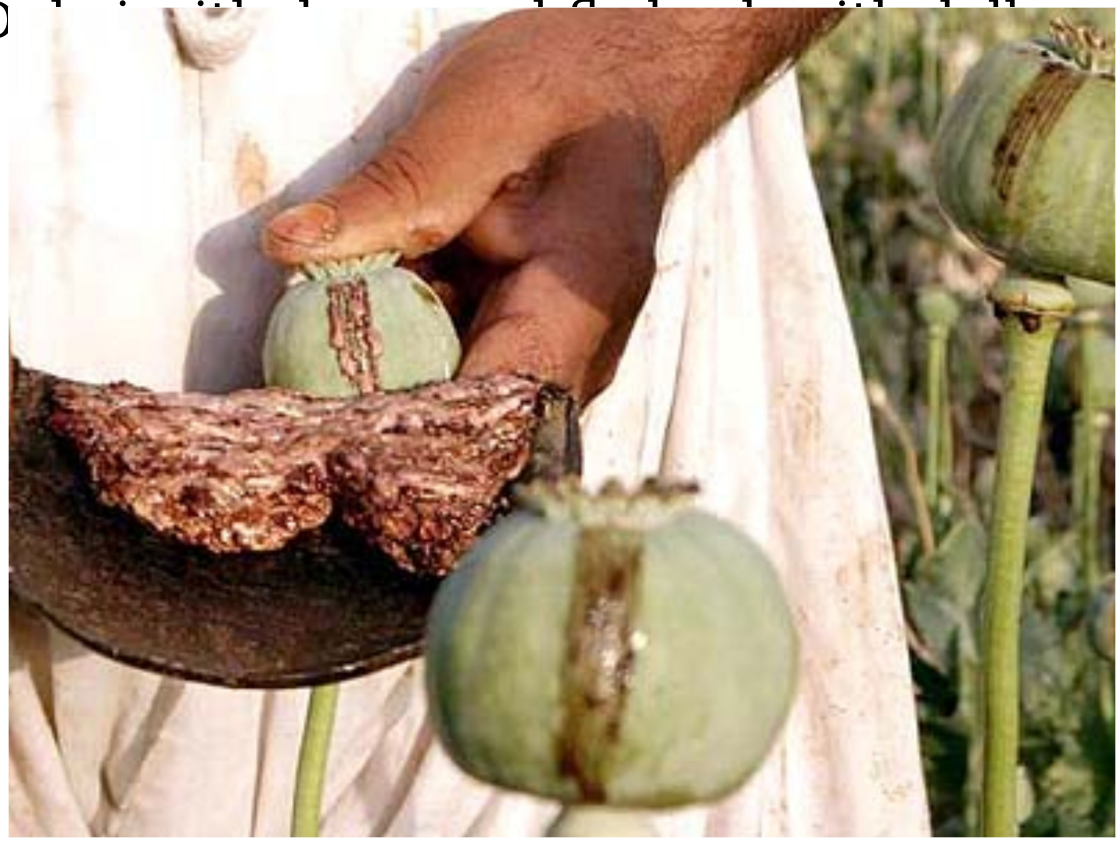
- We need ways to
  1. ***Extract*** relevant parts
  2. ***Access*** this diverse data
  3. ***Represent*** the relationships
  4. ***Model behavior*** of decision makers
  5. ***Predict outcomes*** of our actions and theirs

LCCD Architecture



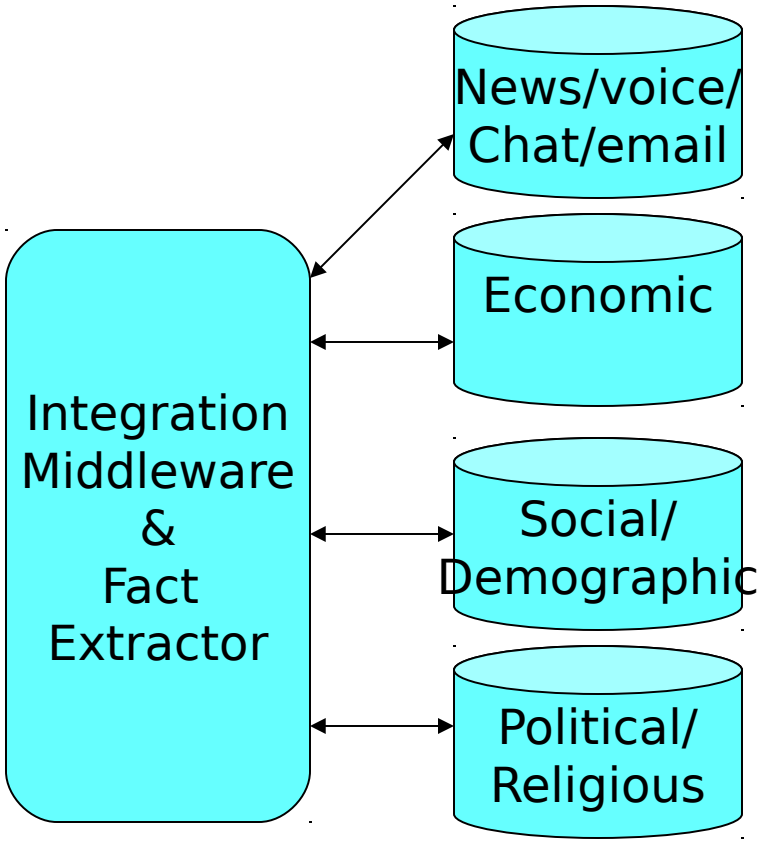
Afghan Drug Trade

- About 3.5M kg per year of opium: largest producer in the world.
  - » Initially headed to Europe.
  - » Large cargo planes fly from Kandahar and Jalalabad to D



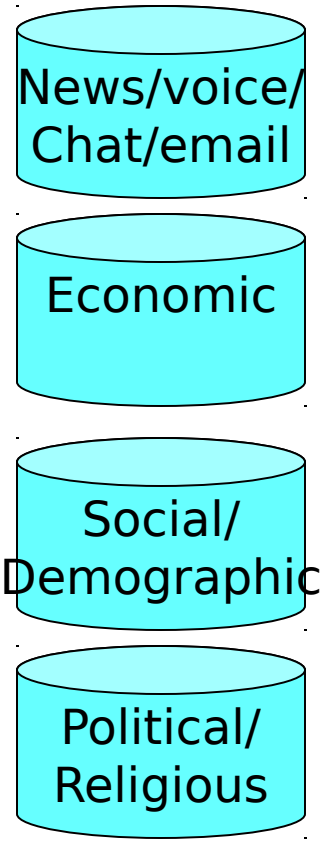
LCCD Architecture
Data Integration & Access

- UMD brings the **IMPACT** integration system (developed with DARPA and ARO funding).
- The system is pretty robust and was featured in ***ComputerWorld***, Sep 12, 2005

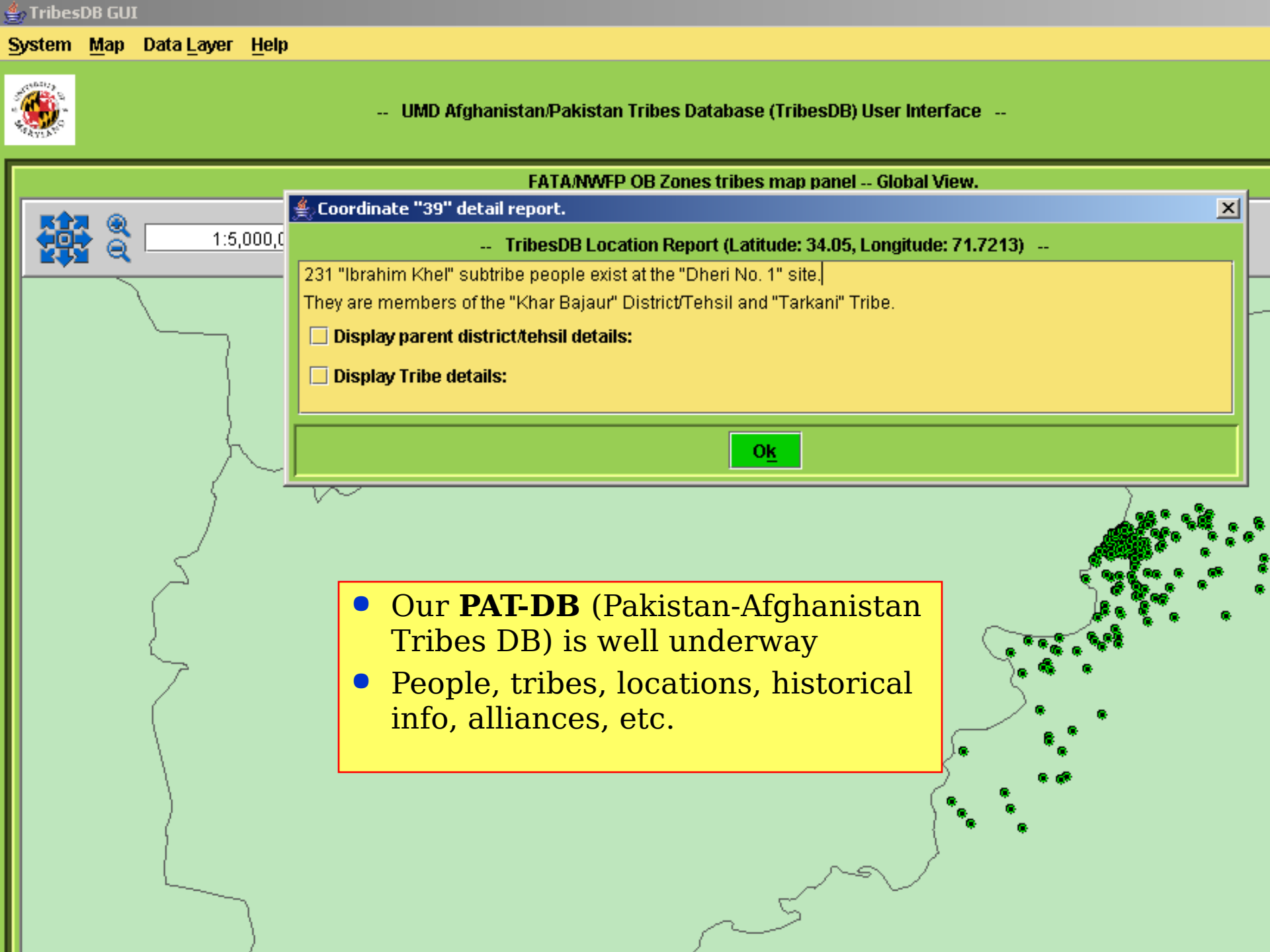


LCCD Architecture
Data Integration & Access (cont'd)

- Characteristics of data/problem
  - » Comes from multiple sources: need to track pedigree. *Pedigree/reliability algebra.*
  - » Inconsistency and Uncertainty are omnipresent. Draw inferences in the presence of incomplete and uncertain information. *Algebra/calculus to integrate information from multiple incomplete/inconsistent data sources.*
  - » Data is obtained from heterogeneous sources. Even accessing these can be a challenge.
  - » Assessing tone/opinion of select sources (e.g. news sources) can be an indicator.
  - » Users need data in English, not SQL.



- Blue: ongoing
- Green: preliminary implementation exists


TribesDB GUI
System Map Data Layer Help
-- UMD Afghanistan/Pakistan Tribes Database (TribesDB) User Interface --
FATA/NWFP OB Zones tribes map panel -- Global View.
1:5,000,0
Coordinate "39" detail report.
-- TribesDB Location Report (Latitude: 34.05, Longitude: 71.7213) --
231 "Ibrahim Khel" subtribe people exist at the "Dheri No. 1" site.
They are members of the "Khar Bajaur" District/Tehsil and "Tarkani" Tribe.
Display parent district/tehsil details:
Display Tribe details:
Ok
Our PAT-DB (Pakistan-Afghanistan Tribes DB) is well underway
People, tribes, locations, historical info, alliances, etc.

Coordinate "39" detail report.

-- TribesDB Location Report (Latitude: 34.05, Longitude: 71.7213) --

231 "Ibrahim Khel" subtribe people exist at the "Dheri No. 1" site.

They are members of the "Khar Bajaur" District/Tehsil and "Tarkani" Tribe.

☑ **Display parent district/tehsil details:**

The "Khar Bajaur" district is subordinate to the "Bajaur" agency of the "FATA" order-of-battle zone.

Description: None listed.

☑ **Display parent agency details:**

"Bajaur" agency description:

The area of [the] Bajaur Agency is 590 square miles. It is a hilly area located on the North of Malakand Agency. The approximate population of the agency according to the latest census is 364,000. The main tribes are Utman Khel and Tarkani of which the major sections are Mamud and Salar Zai. It was created as an Agency from a remote subdivision of the Malakand Agency on [0]1 December 1973 with Headquaters at Khar. Before 1960 Bajaur was treated as an almost wholly inaccessible area and it was in that year that an Assistant Political Agent was appointed whose headquarters were outside the agency at Munda, in Dir District.[^4]

Aside: Extracted from study

☐ **Display parent order-of**

- Our **PAT-DB** (Pakistan-Afghanistan Tribes DB) is well underway
- People, tribes, locations, historical info, alliances, etc.

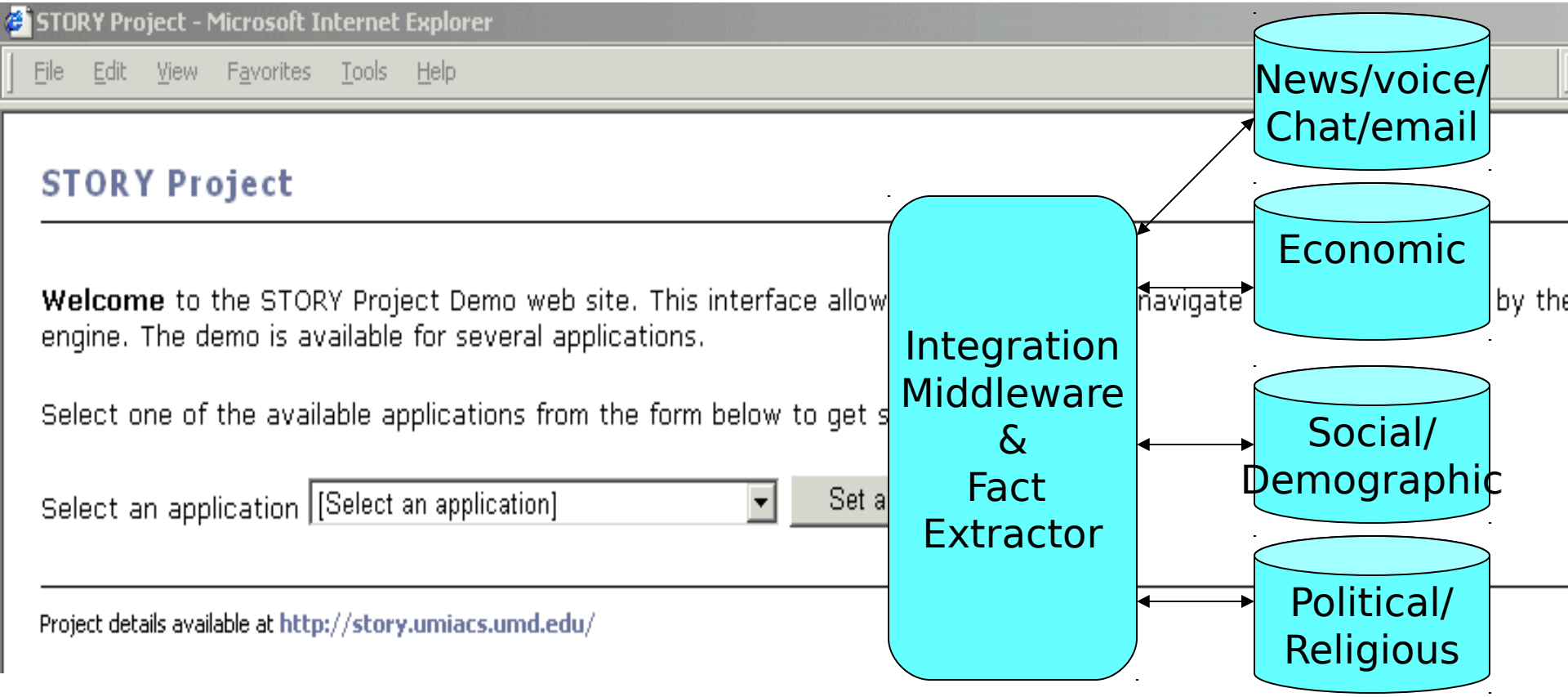
☑ **Display Tribe details:**

"Tarkani" tribe description:

Pushtun tribe TARKANI, or TARKALANRI. Tarkani belongs to the Sarbani branch of the Pushtuns.

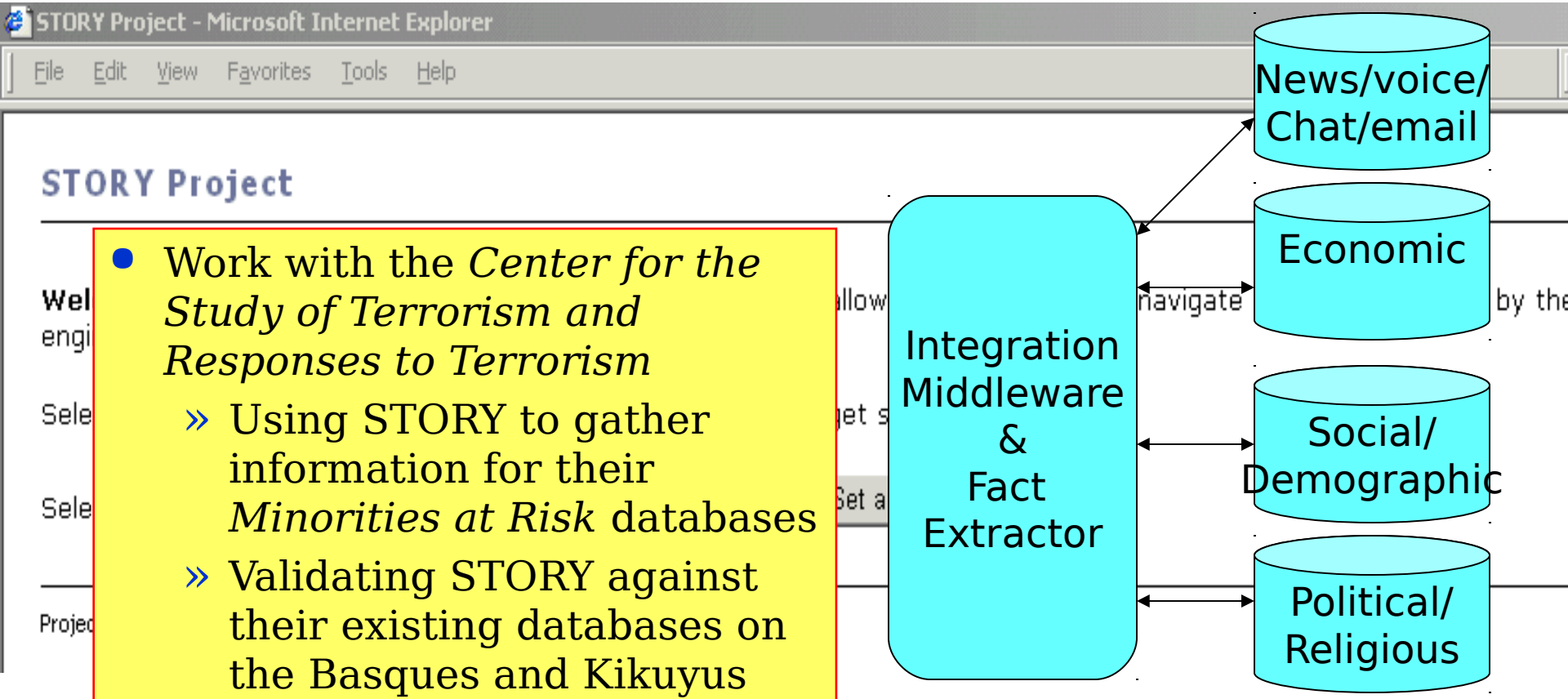
Ok

Architecture
Data Extraction


STORY Project - Microsoft Internet Explorer
File Edit View Favorites Tools Help
STORY Project
Welcome to the STORY Project Demo web site. This interface allow
navigate
by the
engine. The demo is available for several applications.
Select one of the available applications from the form below to get s
Select an application
[Select an application]
Set a
Project details available at http://story.umiacs.umd.edu/
Integration Middleware & Fact Extractor
News/voice/ Chat/email
Economic
Social/ Demographic
Political/ Religious

Our **STORY** system crawls the web to extract RDF triples from textual sources (HTML, PDF, etc.)

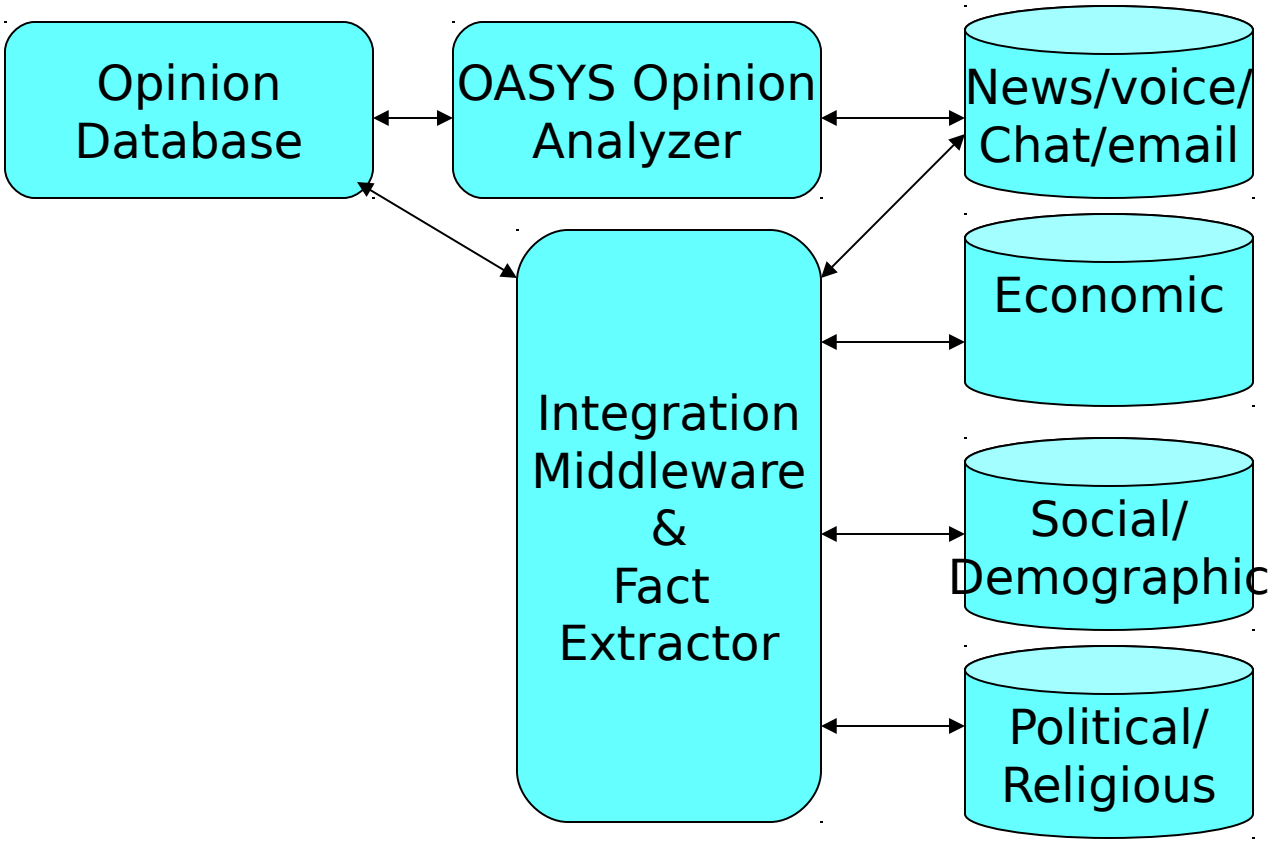
Architecture
Data Extraction



- Work with the *Center for the Study of Terrorism and Responses to Terrorism*
  - » Using STORY to gather information for their *Minorities at Risk* databases
  - » Validating STORY against their existing databases on the Basques and Kikuyus

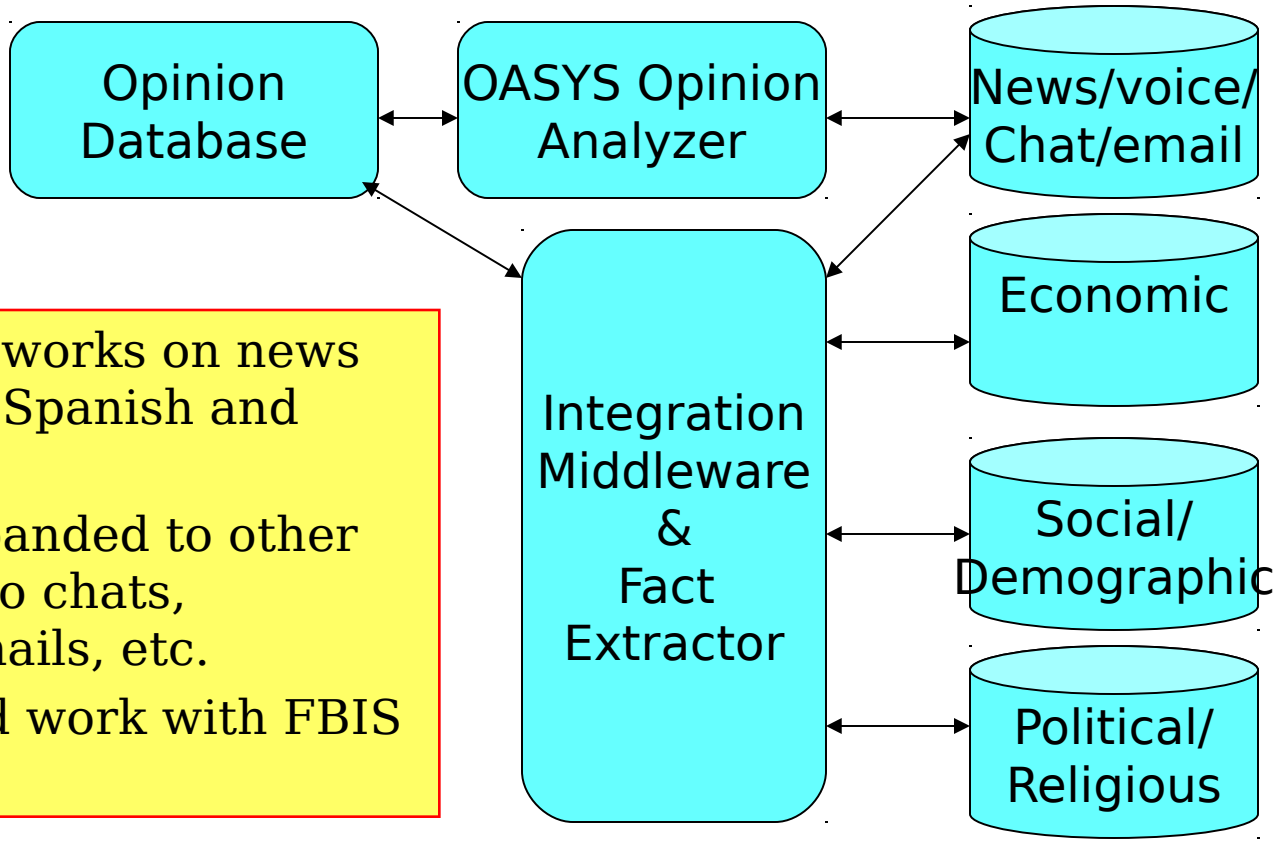
Our **STORY** system crawls the web to extract RDF triples from textual sources (HTML, PDF, etc.)

LCCD Architecture
Opinion Analysis



Our OASYS opinion analysis tool extracts intensities of opinions held by certain groups on certain topics

LCCD Architecture
Opinion Analysis



- Current system works on news only in English, Spanish and Italian
- Needs to be expanded to other languages and to chats, newsgroups, emails, etc.
- Recently started work with FBIS data

Our OASYS opinion analysis tool extracts intensities of opinions held by certain groups on certain topics

OASYS (Opinion Analysis SYStem) - Microsoft Internet Explorer

File Modifica Visualizza Preferiti Strumenti ?

Indietro Cerca Preferiti

Indirizzo http://127.0.0.1/OASIS/system.php Vai Collegamenti

^ top

[Abstract]
[Description]
[Algorithms]
[System]
[Contact us]
[References]

[Abstract] [Description] [Algorithms] [System] [Contact us] [References]

Server Actions Help

Ping Server

Server Management

OASYS

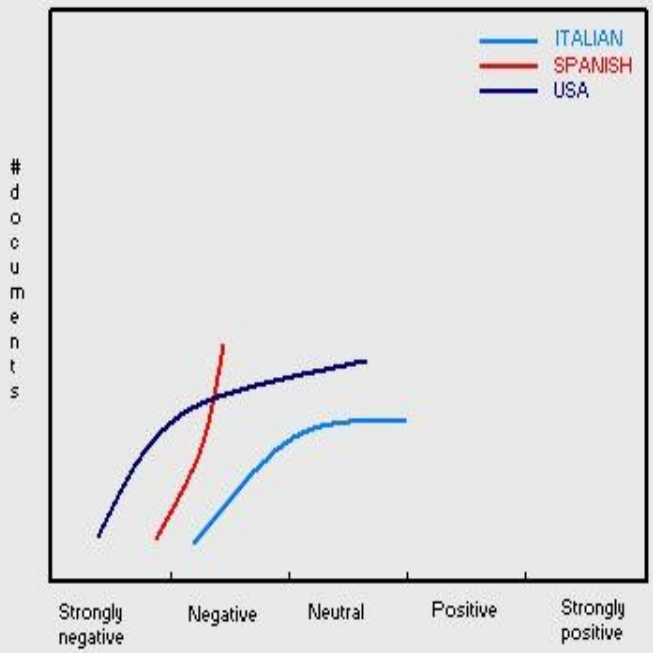
Copyright 2005

Choose Sources

Time Interval

Choose Topic

Harsh Clear

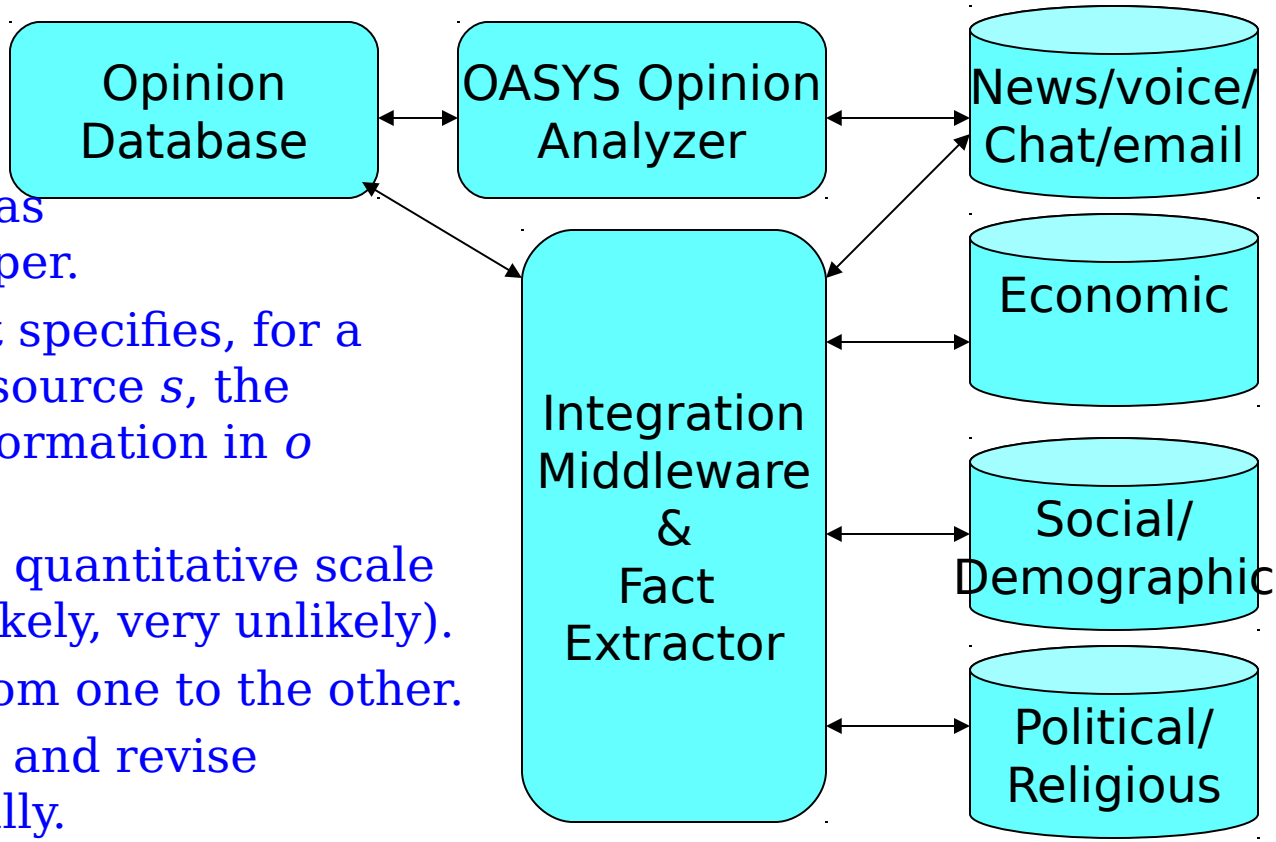


Chosen Sources Chosen Interval Time Chosen Topics

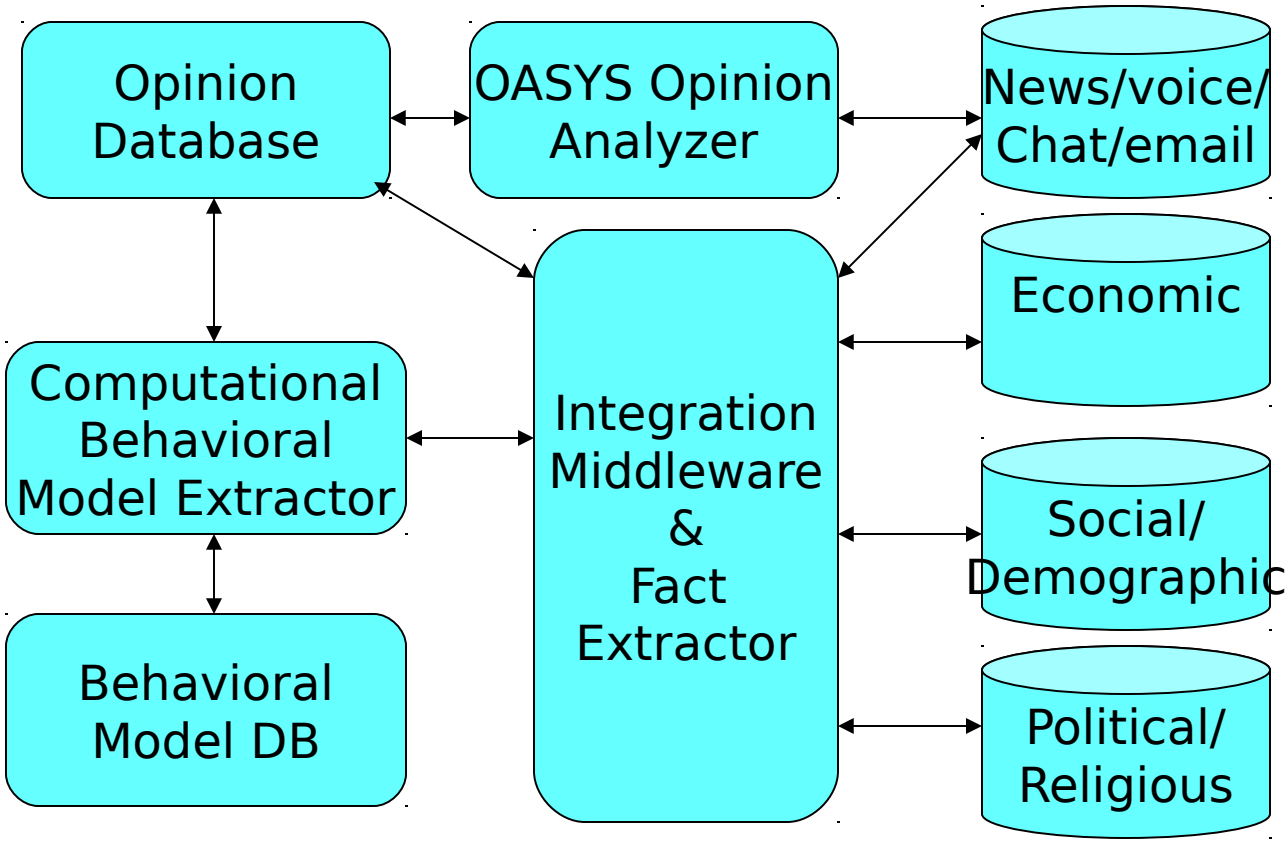
empty empty empty

LCCD Architecture
Opinion Analysis

- Each data source has a provenance wrapper.
- Function $\chi(s,o)$ that specifies, for a given object *o* and source *s*, the reliability of the information in *o* according to *s*.
- Qualitative scale or quantitative scale (likely, neutral, unlikely, very unlikely).
- Algorithms to go from one to the other.
- Algorithms to learn and revise reliability periodically.
- Reliability ontology: reliabilities of sources, subsources, etc.



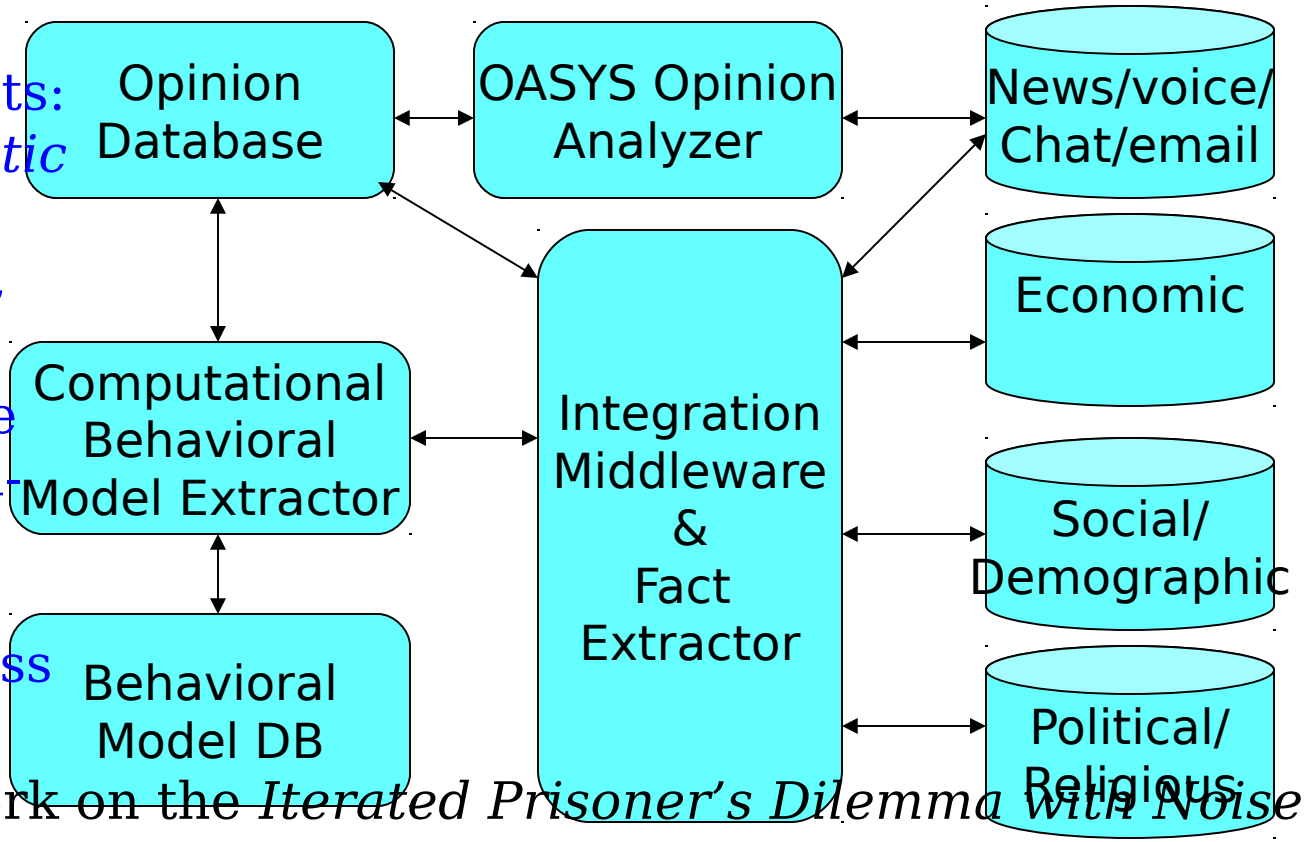
LCCD Architecture Behavior Modeling



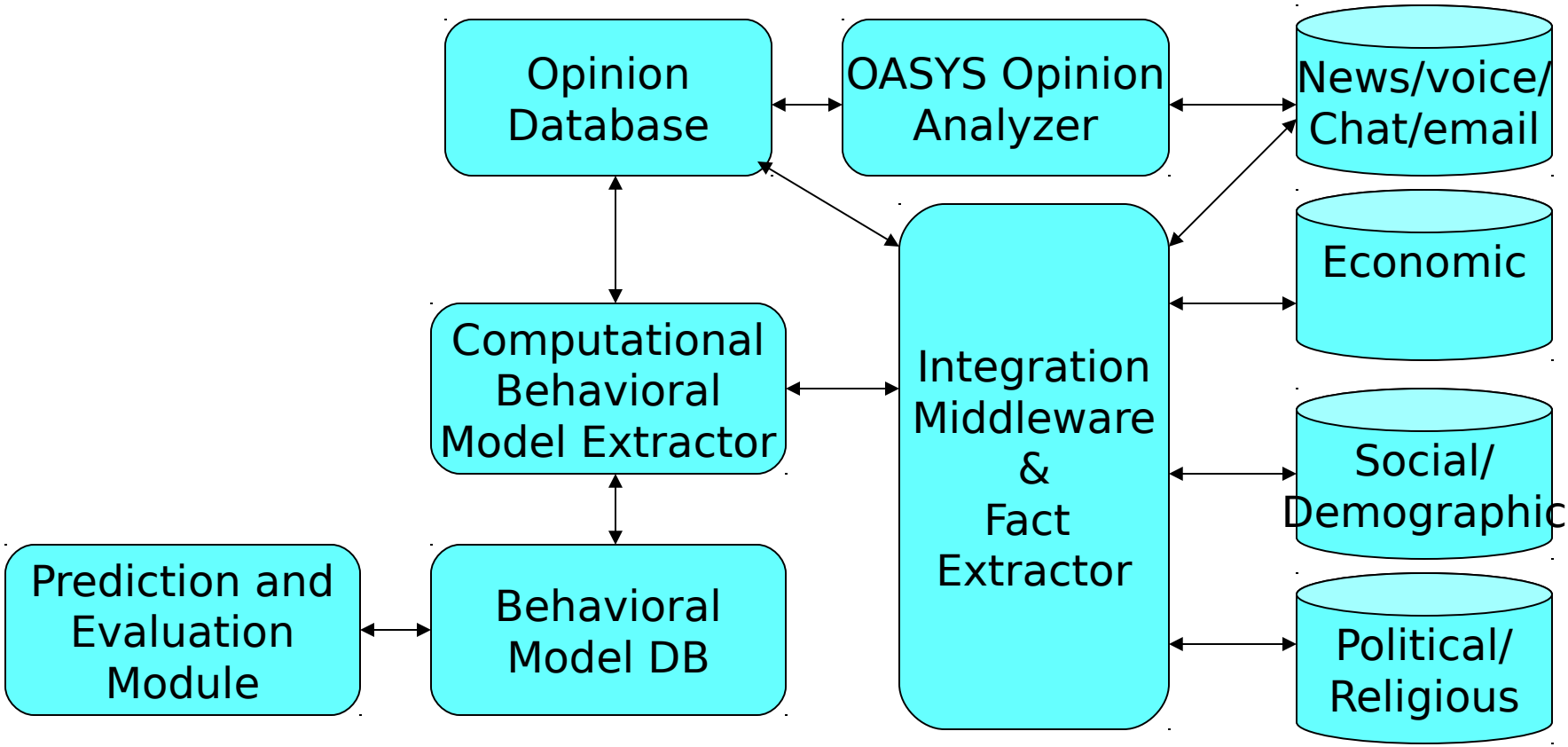
Our computational behavior model extractor will extract ***stochastic rules (qualitative and quantitative)*** about a given terror group from a body of data. Being designed as we speak.

LCCD Architecture Behavior Modeling

- Three components: *qualitative deontic likelihood rules, utility functions, goals*
- Identify plausible things a decision-maker might do that satisfy the rules and progress towards the goal
- Builds on our work on the *Iterated Prisoner's Dilemma with Noise*
  - » Best performer in the "noise" track of the recent 20th Anniversary Competition (except for the "master & slaves" strategies)
  - » [Au & Nau, submitted for publication]



LCCD Architecture
Prediction and Evaluation



Use the computational behavior models and data sources to identify what a given group will do in a given situation. Being designed as we speak.

LCCD Architecture Prediction and Evaluation

- We can view this as a game tree problem where
  - » Nodes ↔ situations
  - » Edges ↔ moves that we or others can make
- Model-based game trees [Au & Nau, submitted for publication], *but*:
  - » *Much* more complicated than Iterated Prisoner's Dilemma
  - » Enormous search space
- Strategies we propose to follow:
  - » Next two slides

LCCD Architecture Prediction and Evaluation

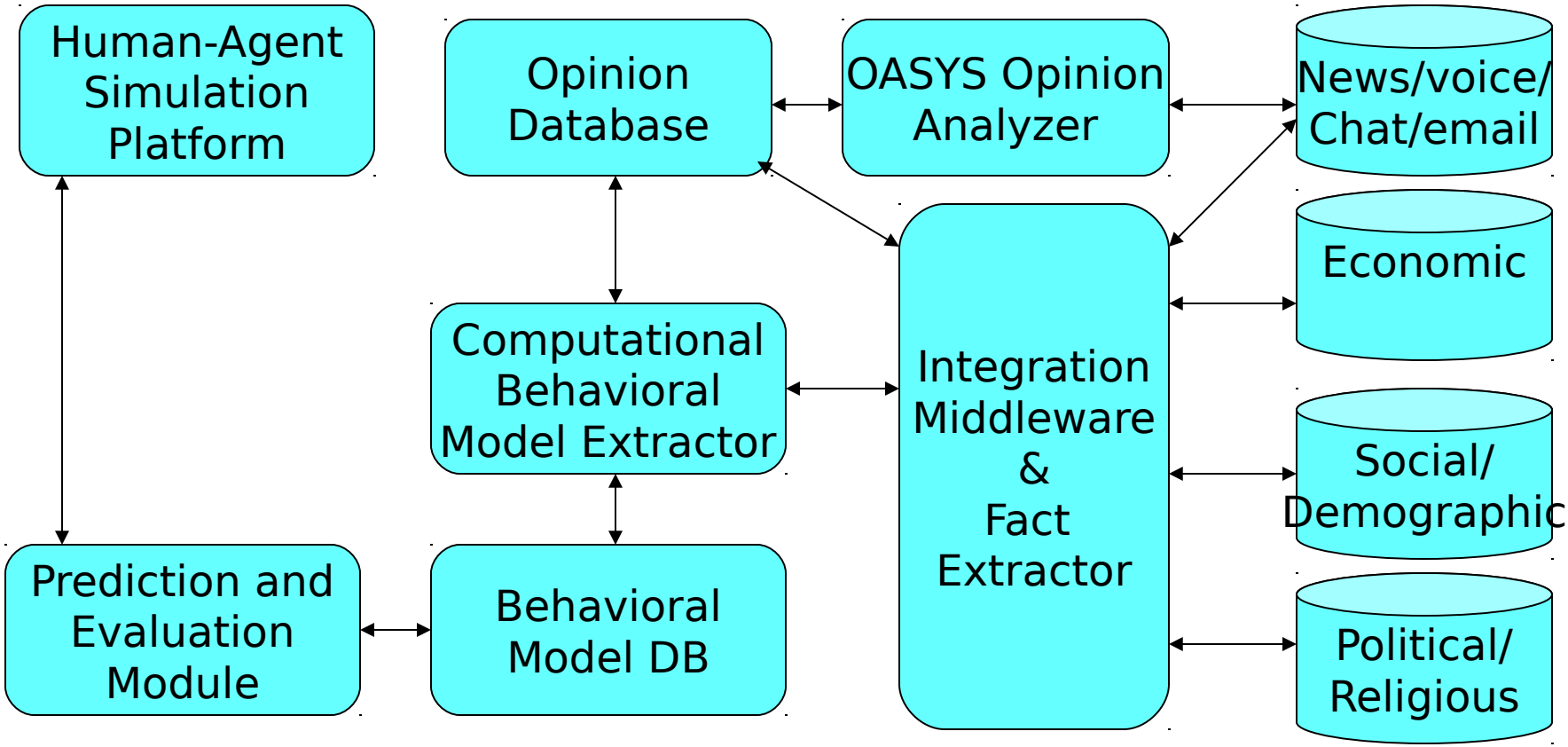
- Strategy based game trees
  - » Smith, Nau, & Throop win *World Computer Bridge Competition*, 1997
    - Articles in *Washington Post, New York Times*
  - » [Smith, Nau, & Throop, *Comp. Intelligence* 1996, *ECP*-97, *IAAI*-98, *AI Magazine* 1998]
- Plan generation & evaluation using abstraction and decomposition
  - » SHOP2 planning system [Nau *et al., IJCAI-99, JAIR* 2003, *IEEE Intelligent Systems* 2005]
    - Award winner in the 2002 International Planning Competition
  - » Extensions for planning under uncertainty [Kuter & Nau, *AAAI*-04, *AAAI*-05, *ISWC*-05, *ICAPS*-05]
- Statistical simulation based on random hypotheses of what the enemy might do
  - » [Parker, Nau, & Subrahmanian, *IJCAI*-05]

LCCD Architecture Prediction and Evaluation

- Algorithms to find a set S of actions that optimize any given objective function and satisfy a set of deontic rules
- Fast algorithms to find sub-optimal solutions
  - » [Stroe, Subrahmanian, Dasgupta - *AAMAS 2005* best paper award nominee. (4 nominees of ~530 papers)]
  - » [Dix, Kraus, Subrahmanian – *ACM Trans. On Computational Logic*, to appear 2005]

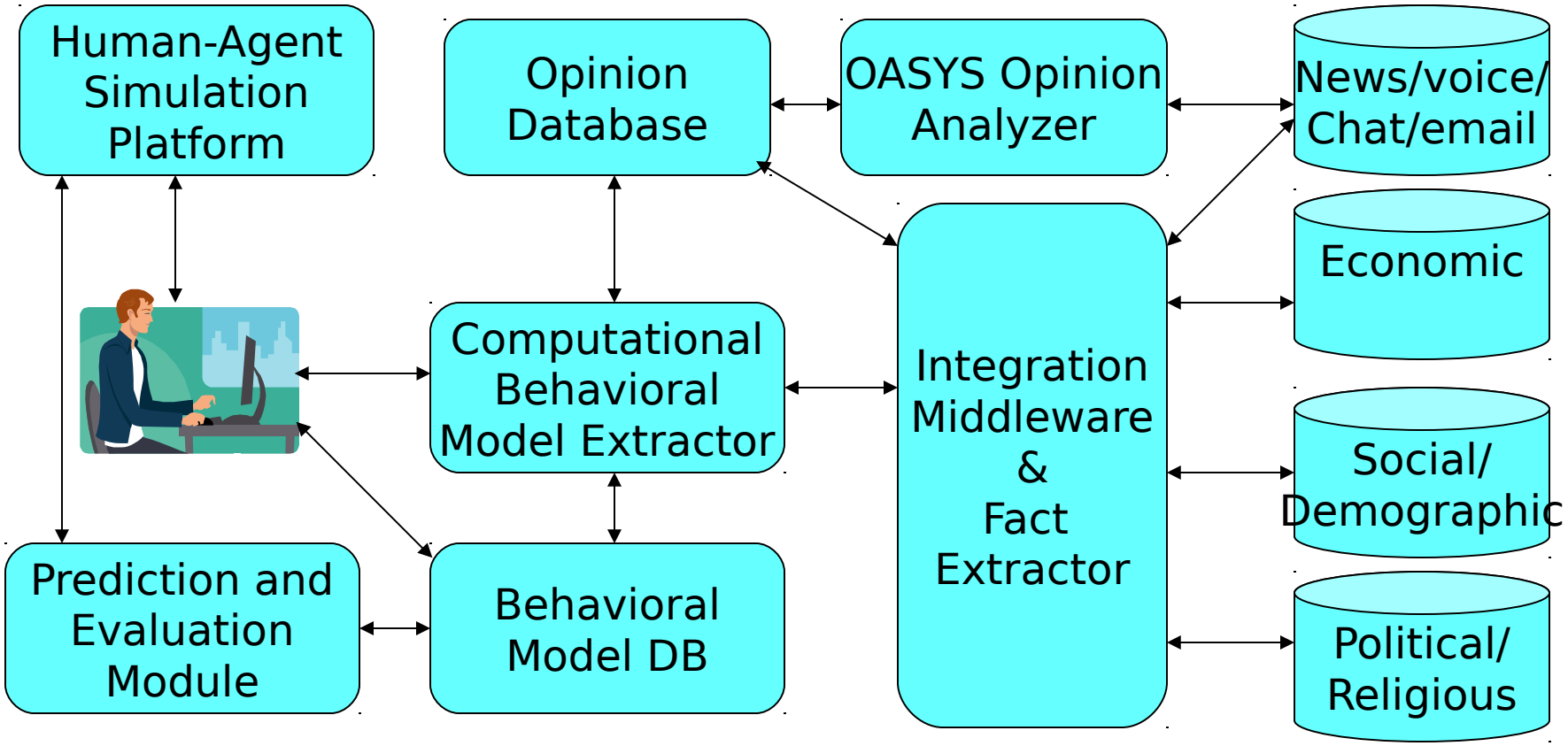
- Survey paper that ties a lot of this together [Nau, Parker, & Subrahmanian, to appear]

LCCD Architecture Simulation



Our human agent simulation platform will determine how a given set of actions will "play out" in a given situation when different roles in the simulation are played by either humans or software agents. Will include methods to *automatically refine* behavioral models based on human play.

LCCD Architecture Simulation

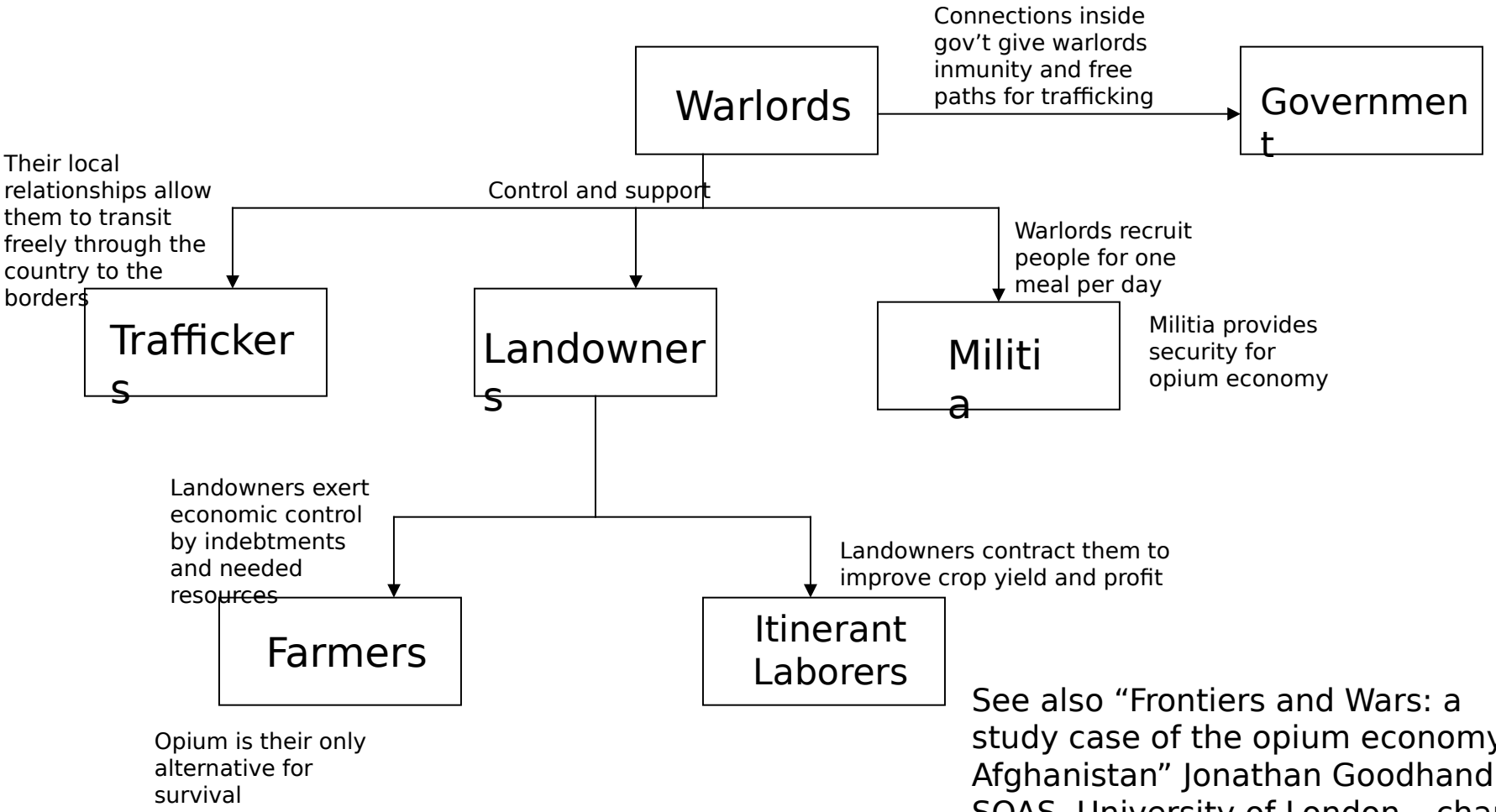


Humans will be in the loop. They will be able to provide/correct behavioral models, query the databases or extracted facts, query the opinions found, and provide feedback and corrections as desired.

Afghan Drug Trade

- Initially, most poppy fields in Helmand, Kandahar, Uruzgan, Nangarhar
  - » Pashtun belts in the south and east, divided up among many warlords
  - » Farms tend to be small
  - » Cultivating wheat per hectare yields 1500 USD per year, while opium yields 15000
- Now poppy fields in 28 provinces.
- 400 estimated drug labs
  - » Acetic anhydride used in the labs comes from Hungary and India

Role Hierarchy in Afghan Opium Economy


Warlords
Connections inside gov't give warlords inmunity and free paths for trafficking
Governmen t
Their local relationships allow them to transit freely through the country to the borders
Control and support
Warlords recruit people for one meal per day
Traffickers
Landowners
Militia
Militia provides security for opium economy
Landowners exert economic control by indebtments and needed resources
Landowners contract them to improve crop yield and profit
Farmers
Itinerant Laborers
Opium is their only alternative for survival

See also "Frontiers and Wars: a study case of the opium economy in Afghanistan" Jonathan Goodhand, SOAS, University of London – chart on page 10.

Conclusions

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